APPLICATION OF FRACTAL METHODS FOR TIME SERIES ANALYSIS

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It is known that time series are widely used in describing stochastic processes in medicine, sociology, and others. Time series analysis is the basis for the development and verification of models that allow to consistently represent the evolution of complex systems.

One of the most important qualitative characteristics of fractal objects is the concept of fractal dimensionality, or similarity index, which describes the repeatability of the geometry of a time series or its statistical characteristics when the scale of measurements changes.

When analysing a time series by fractal methods, researchers often encounter a situation when a single indicator of fractal dimensionality is insufficient to describe the dynamics of the process. This result is explained by the mixed nature of the time series. In these cases, we speak about a multifractal system, which is a generalisation of a fractal system, and about the time series analysis by special multifractal methods. These include the method of multifractal analysis and methods based on Fourier and wavelet transforms.

By definition, a multifractal is fractals set characterised by its dimensionality. This raises the necessity to construct a continuous spectrum of fractal dimension indexes. The multifractal spectrum shows the scaling indexes distribution, a measure of how the local properties of objects change over time.

The authors in a number of works carried out a study of fractal and multifractal dimensionality of real time series, during which it was found out that the studied time series is not a monofractal. In this regard, it became necessary to study the series by the method of multifractal analysis.

Justification for the use of this method served as the authors' desire to reveal the influence of the military crisis in the USSR in the 40s of the twentieth century on the multifractal properties of the time series of socially-oriented indicators, the formation of which began at the end of the XIX century in tsarist Russia.

For this purpose, the sections of the series were analysed separately. One of these sections precedes the crisis interval 1941-1952, and the other one follows it. Application of the multifractal analysis method to the two intervals allows us to conclude that due to the crisis the spectral function acquires a wider interval of change in fractal dimensions. Thus, we can conclude that the crisis leads to the strengthening of multifractal properties of time series.